The following papers were read:—

1. A Description of *Wynyardia bassiana*, a Fossil Marsupial from the Tertiary Beds of Table Cape, Tasmania. By Baldwin Spencer, M.A., F.R.S., C.M.Z.S., Professor of Biology in the University of Melbourne, Director of the National Museum, Melbourne.

[Received July 9, 1900.]

(Plates XLIX. & L.)

For many years the Tasmanian Museum in Hobart has been in possession of a block of calcareous sandstone, obtained from the "Turritella-zone" in the Tertiary beds of Table Cape, containing, partly exposed to view, the remains of a marsupial, which in life must evidently have been of the size of a large Phalanger, though of stouter and more massive build than any existing one.

I have to express my cordial thanks to the Council of the Museum and to the Curator, Mr. Morton, for the opportunity of examining the specimen, the especial interest of which lies in the fact that it is the oldest marsupial yet found in Australia, as the Turritella-zone is regarded, from palæontological evidence, as belonging to the Eocene deposits [1].

Whilst a large number of fossil mammals from Australia have been dealt with by Owen, McCoy, de Vis, Stirling and Zietz, Broome, and others, none of an age earlier than Pleistocene have been hitherto discovered, the specimen now described being the solitary one as yet found in Australia which dates back as far as the Tertiary period. Pleistocene fossils reveal the existence of highly specialized forms such as *Thylacoleo* and *Diprotodon*, associated with representatives of living genera; whilst the Eocene form appears to be in no way highly specialized, but unites within itself structural features which serve to ally it, on the one hand, with the most generalized of the Diprotodontia—the Phalangeridæ, and on the other hand with the most typical Polyprotodontia—the Dasyuridæ. This is exactly what we might expect to find, on the supposition that the present Diprotodont marsupials of Australia have been developed in the Australian region from earlier Polyprotodont forms, and that the more highly specialized Diprotodonts were comparatively late developments.

The earliest and, in fact, the only reference to the fossil occurs in Johnston's 'Geology of Tasmania,' where it is briefly described as "the almost perfect skeleton of a species of *Halmaturus* obtained

[1] G. B. Pritchard, "A Revision of the Fossil Fauna of the Table Cape Beds, Tasmania," Proc. R. S. Vict. 1895, p. 74. Professor Tate, however, has recently referred the beds, doubtfully, to the Oligocene: Trans. R. S. South Austr. vol. xxiii. pt. i. p. 107.

embedded in the 'Turritella-zone' of the marine beds at Table Cape"[1]. Unfortunately it is far from being nearly perfect.

Table Cape itself is a promontory near to the little township of Wynyard and looks out northwards across Bass Strait. Close to it are two small bluffs, from one of which[2] the specimen was obtained. The bluff is about 160 feet high, with a capping of basalt, beneath which lie the Tertiary beds, which in their turn rest on Silurian slates. The upper Tertiary beds, called by Johnston the "Turritella-zone," are about 80 feet where fully exposed and contain in addition to marine forms leaf-impressions. The same author says: "With respect to the occurrence of the plant-remains amongst marine forms, it is most probable that the calcareous sandstones were formed at the mouth of an estuary or river, and that the leaves and other land organisms were washed down and included with the marine forms. This interpretation also throws some light upon the discovery of the almost complete skeleton of the species of *Halmaturus* already derived from the calcareous sandstone." In regard to the underlying Crassatella-bed, he says: "It hardly deserves to be considered as distinct from the Turritella group which rests immediately upon it, were it not for the fact that it appears to have been accumulated under different circumstances."

Pritchard[3] says in regard to the collection of shells studied by him that it "came principally from the lower deposits known as the Crassatella-beds, and judging from the fossils I regard the zone as the direct equivalent of the so-called middle beds of the Spring Creek section in Victoria. The coarseness of the material in which a number of the Table Cape fossils is preserved, the worn character of many of the species, and the abundance of fragments of shells clearly indicate the littoral character of the deposit, and as an attendant fact of some importance we have certain faunal characteristics indicative of the same feature."

In their suggested arrangement of the sequence of the Eocene rocks of Victoria, Messrs. Hall and Pritchard place the Spring Creek beds at the base of the series[4].

The block of sandstone, as it was originally found, had broken off from the face of the bluff and tumbled down to the base, which was surrounded, when the author visited the spot in 1892 in company with Professor Tate, with masses of various sizes strewn about in all directions. Evidently this fall from the upper part of the bluff had smashed the block in such a way as to partially expose the fossil, and subsequent weathering resulted unfortunately in the breaking off of the lower part of the skull; though it is quite possible that considerable damage had been done to the skull before it was embedded, as the part of the lower jaw enclosed in the matrix, and so not exposed to recent weathering, has all of

[1] Pp. 261, 288 *et seq.*

[2] Figured and described by Mr. Johnston, *op. cit.* pp. 258 *et seq.*

[3] Proc. R. S. Vict. 1895, p. 77.

[4] Proc. R. S. Vict. 1894, p. 180. "The older Tertiaries of Maude with an indication of the sequence of the Eocene Rocks of Victoria."

its teeth broken away. That it must have lain for some time exposed within reach of the tide is shown by the fact that a barnacle three quarters of an inch in diameter has grown attached to a fragment of the sacral region. When it was originally found (and as it came into my hands) only a small portion of the broken under surface of the skull was visible. A portion of one side of the lower jaw, parts of ten vertebral bodies, a portion of the sacrum, a broken ilium, various bones of the hinder limbs, one of the marsupial bones, and parts of ribs were also visible. All traces of teeth, shoulder-girdle and front limbs, hind feet and tail were unfortunately lacking. The ten vertebræ are but little disturbed, the zygapophyses of eight fitting closely on to one another.

By dint of careful working, the comparatively soft matrix which is full of Turritella-shells was removed, and the remains of the skull, lower jaw, femur, and tibia were extracted. One of the coronoid processes was found between the zygoma of the right side and the cranium, detached from the lower jaw and inverted in position; but though a considerable part of the matrix has been worked away, not a trace of a tooth could be found. There can be little doubt but that the lower jaw and pelvic girdle had been smashed before the specimen was finally embedded in the matrix; the pectoral girdle and limbs and possibly also the hind feet were contained in the part of the block from which the preserved portion was broken off, while weathering will account for the damage done to the lower part of the skull and the hind-limb bones.

The strongly inflected angle of the lower jaw, the general structure of the skull and the marsupial bones indicate the essentially marsupial nature of the animal; but at the same time it will be seen, when dealing with various parts of the skeleton, that this early Australian mammal shows structural features which in certain respects are not characteristic of living marsupials, and in others are characteristic of various groups belonging on the one hand to the Diprotodontia and on the other to the Polyprotodontia.

The name of *Wynyardia bassiana* is proposed for the fossil, the generic name being derived from that of the township close to which lie the Table Cape beds in which it was found.

The Skull. (Figs. 1 & 2, Pl. XLIX., & fig. 5, Pl. L.)

The upper surface of the skull is fairly intact, but the lower is unfortunately broken, the exoccipital and basioccipital, the auditory bullæ and the palatal region being absent.

The most striking features are (1) the considerable relative size of the cranial as compared with the facial portion, (2) the strong development of the sagittal crest and the lambdoidal crista, (3) the broad sweep and upward curvature of the zygomatic arch, (4) the large size of the squamosal, (5) the large size of the lachrymals,

which meet the nasals and prevent the maxillæ from coming into contact with the frontals, (6) the great width of the nasals, (7) the very anterior position of the infraorbital foramen, and (8) the general massiveness.

Owing to the base of the skull being broken, the length measurement from the basion to the gnathion cannot be taken, and therefore, for the purpose of comparison with other skulls, the total length from the posterior end of the sagittal crest to the anterior end of the nasals, that is the total length along the mid-dorsal line, is taken. Though this is not so satisfactory as the former measurement, still it will serve to a certain extent as a basis of comparison.

The total length is just 100 mm., and the greatest width across the zygomata is 67 mm. Taking the same length of various species of marsupials, measured for comparison, as 100, we find that the proportionate breadth is as follows :—*Trichosurus fuliginosus* 58·7, *T. vulpecula* 53·7, *Pseudochirus herbertensis* 60, *P. archeri* 63·8, *P. cooki* 53·7, *Phascolarctos cinereus* 59, *Cuscus* sp. 59, *Bettongia penicillata* 56·3, *Dendrolagus bennettianus* 55·7, *Phascolomys mitchelli* 75·2, *Dasyurus maculatus* 68·2, *Sarcophilus ursinus* 77, *Didelphys* sp. 56·9. In regard to this it is intermediate between such extreme forms as *Sarcophilus* on the one hand and *Petrogale* on the other, and approaches most nearly to *Dasyurus*, showing a decidedly greater width than is met with in the Phalangeridæ.

The occipital region is separated from the upper surface of the skull by a well-marked lambdoidal crista which curves somewhat backward, so as to afford a concave surface for the muscles of the neck, the occipital plane sloping slightly downwards and forwards and not being vertical as in most marsupials. The curvature of the ridge is carried to about the same extent as it is in *Dasyurus*, the ridge of either side curving slightly towards the middle line.

From a point just behind the intertemporal constriction a strongly marked sagittal crest runs backwards to the lambdoidal crista, the former being as well developed as in *Thylacinus* and *Dasyurus*. In this respect the fossil offers a strong contrast to the Phalangeridæ, in which the two temporal ridges run backwards converging towards the lambdoidal crista; so that no such sagittal crest is formed as is characteristic of the Dasyuridæ, and is seen also in *Didelphys marsupialis*. On the upper surface of the frontals there is a shallow, but sharply outlined, depression, the converging margins of which are continuous posteriorly with the sagittal crest. The parietal suture extends about as far forwards as the latter.

A very remarkable feature is the great extent and anterior extension of the squamosals, the anterior ends of which reach almost as far forwards as those of the parietals. An equally striking feature, and one in which the fossil agrees with *Dasyurus* and *Sarcophilus*, is the general parallelism of the upper part of the suture of the squamosal with the sagittal crest. In such forms as the Phalangeridæ for example the sutures show a continuous marked convergence towards the middle line posteriorly. In regard

to the straightness and to a certain extent the length of the squamosal suture, the fossil resembles *Phascolomys* and *Phascolarctos*, from both of which it differs, however, to a great extent in other features. The squamosal is indeed larger than in any existing or fossil marsupial yet known, and its forward extension completely prevents the alisphenoid from coming into contact with the parietal as it does in most marsupials, such as *Phalanger*, *Trichosurus*, *Pseudochirus*, and *Dasyurus*; though, on the other hand, the parietal does not reach the alisphenoid in *Peragale*, *Æpyprymnus*, and *Phascolomys*, with which in other respects the fossil has but little in common.

No intertemporal bone can be detected.

The zygomatic arch is strong and massive, most resembling in form that of the Dasyuridæ both in the considerable outward sweep of the hinder part and in its marked upward curvature; in the former respect it most nearly resembles a large skull of a *Dasyurus*, and in the latter that of a *Sarcophilus*. There is not a trace of the swollen posterior part of the squamosal which is such a striking feature in certain of the Phalangeridæ, such as the genera *Phalanger*, *Trichosurus*, *Pseudochirus*, and *Petaurus*; but, in strong contrast to what is characteristic of these forms, the arch arises low down, and, as is well seen in lateral view (fig. 5, Pl. L.), the upper surface rises immediately so as to form a strongly marked curve: at the same time the arch flattens out laterally, bends over (fig. 1) towards the upper surface and runs forwards to be inserted into the notch in the malar process of the maxilla. The latter process is well developed and passes off almost at right angles to the side of the maxilla, bending abruptly backwards and at the same time outwards to be attached in the characteristic way to the hinder end of the arch, beneath which it runs backwards to the glenoid cavity. The abrupt bend of the malar process most resembles that of *Phascolarctos*, though in the latter the main body of the arch runs parallel to the length of the skull. In the Phalangeridæ the bend is a more gradual one, and the sweep of the arch is not nearly so pronounced as it is in this fossil form. Though the lower part of the arch is broken away, it appears probable that there was a slight zygomatic process at the anterior end; and, as in *Trichosurus* and certain other genera, only still more markedly, there is a very distinct ridge (Pl. L. fig. 5), which traverses almost the length of the arch, and sharply marks off an outer and upper from an outer and lower surface, the latter serving for the attachment of the masseter muscle.

The glenoid cavity is considerably elongated transversely, the downward process which bounds it posteriorly being, as in the Dasyuridæ and *Perameles*, apparently independent of any structure concerned with the auditory passage. The shape and relationships of this process are most similar to those of *Thylacinus*, and differ markedly from those which obtain in the Phalangeridæ, amongst the members of which the process in question forms the anterior part of a well-marked bony canal. Also, as in *Dasyurus*, the

meatus is directed outwards and a little forwards. The glenoid cavity is placed neither very high nor very low in regard to the base of the skull; it is higher than in the Dasyuridæ, where it is more nearly on a level with the base of the skull, and somewhat lower than in the Phalangeridæ, though it approximates more nearly to the position in the latter.

The frontals show only a faint trace of a postfrontal process tending to bound posteriorly an orbital space; their greatest width occurs in the cranial and not in the facial portion—a feature which is the reverse of that which is characteristic of marsupials, amongst whom the broadest part of the frontal is characteristically found in the facial part of the skull. Dorsally the frontal region is marked by a concavity of a V-shape, sharply outlined. This concavity is nothing like so wide nor so extensive in length as it is in *Cuscus*, *Trichosurus*, and *Pseudochirus*, from which it differs markedly in appearance and very much more resembles that of *Dasyurus*. Its posterior end, which practically corresponds in position with that of the least intertemporal width, is marked by the commencement of the sagittal crest.

The lachrymals are of large size and extend upon the face to such an extent that, owing partly to the width of the nasal bone, they come into contact with the latter and so prevent the upward process of the maxilla from reaching the nasal. This feature is also met with in *Phascolomys*, while in some of the Phalangeridæ also the lachrymal extends very nearly to the nasal. A very characteristic feature of marsupials is seen in the extra-orbital position of the lachrymal foramen, which is single and placed as in *Sarcophilus*.

The nasals present two points of importance—first, the considerable expansion of their upper ends, the greatest width occurring at rather more than a quarter of the length from this point; and second, the forward extension of the bones beyond the premaxillæ so that they overhang the nasal cavity. Their greatest length is 40·5 mm. and the greatest width 18·5 mm. The expansion which brings the nasals into contact with the lachrymals is indeed more marked than in the Phalangeridæ, *Dasyurus*, and certain Didelphyidæ in which it is characteristically present. In the forward projection of the bones over the nasal cavity, the skull differs from that of the Dasyuridæ and agrees with those of *Phalanger*, *Trichosurus*, *Pseudochirus*, and certain species of *Didelphys*; in fact the general structure and relationships of the nasal bones recall most strongly that which obtains in the latter.

The lower part of the maxillary bone is broken away at the level of the infraorbital foramen, but there are two features of importance. First, the upward process, as already described, is completely shut off from contact with the frontal; and second, the infraorbital foramen is situated close to the suture between the maxilla and premaxilla, being considerably farther away from the orbit than in any existing marsupial.

The premaxillæ are of large side, approximating most in form

to those of *Trichosurus*, and their dimension would appear to indicate the existence of a fair-sized incisor dentition. It is most unfortunate that the lower part of the premaxillæ should have been broken away at such a level as to leave no indication of the exact nature of the teeth.

With regard to the ventral surface, the specimen is so broken that it is not possible to say much. The palate is completely wanting; parts of the basi- and presphenoid remain and the ento-carotid canals, as is characteristic of marsupials, pierce the basisphenoid and enter the skull close to the middle line, the opening on the right side being larger than that on the left. Each artery runs forward in a deep strongly marked groove, the two grooves converging anteriorly. These grooves, which lead forwards from behind the level of the foramen ovale on each side, are considerably longer and more strongly developed than in any other marsupial and are well seen in the figure of the under surface of the skull (Pl. XLIX. fig. 2).

The foramina leading from the skull, so far as they remain, agree in essential features with those of marsupials. The optic foramen and the foramen lacerum anterius are united to form a sphenoidal foramen opening outwards from the sella turcica, and the foramina of the two sides are confluent, so that in lateral view (fig. 5) of the skull there is a small but well-marked opening leading from the lower part of the temporal fossa of one side into that of the other. The passage thus formed is bounded below by the basisphenoid and presphenoid, the suture between which lies in the floor of the cavity, and above by the ali- and presphenoids. A similar passage is seen in *Macropus*, *Trichosurus*, *Pseudochirus*, *Phascolomys*, and *Dasyurus*, but is quite wanting in other forms such as *Phascolarctos* and *Sarcophilus*. The foramen rotundum opens close to the outer and slightly to the under and posterior side of the sphenoidal foramen, from which it is as usual only separated by a thin plate of bone.

Within the cavity of the skull the entocarotid canals enter close behind the sella turcica, the right being twice the size of the left. The sella turcica has no posterior clinoid process, and from the foramen rotundum of each side a well-marked groove leads back to the Gasserian fossa, the outer edge of the groove being formed by the projecting ridge of bone which is developed from the alisphenoid in the tentorial plane. The same feature occurs in *Macropus*, *Sarcophilus*, and *Dasyurus*. The periotic lies completely behind the ridge marking the tentorial plane, the bony structure in which is not very strongly developed in contrast with what obtains, for example, in *Cuscus* and *Trichosurus*. The periotic differs from that of other marsupials, first in its relatively small size, and secondly in its structure. The lower part, in which lies the auditory meatus, has, facing the cerebellar cavity, a nearly vertical surface measuring 8 mm. by 5 mm. in height; above this portion the bone is impressed so as to form a horizontal platform from which, on the outer and posterior sides, rise the thin curved

plates which are attached to but not fused with the skull-wall. It thus differs markedly from that of other marsupials, in almost all of which there is a well-marked pit for the lodgment of the lateral appendage of the cerebellum. In the Wombat the pit is represented by a depression, but there is no horizontal platform developed, and the whole structure is very different from that of the fossil.

The cranial cavity is relatively of considerable size as compared with that of recent marsupials. Some idea of this may be gained from the following measurements [1], which, for the sake of more easy comparison, have all been reduced so as to make them proportionate in dimension to skulls of the same length [2] as that of the fossil specimen (100 mm.):—

	Fossil.	*Trichosurus vulpecula.*	*Dasyurus maculatus.*	*Macropus rufus.*	*Phascolomys mitchelli.*	*Perameles gunni.*	*Sarcophilus ursinus.*
Total length of cranial cavity ...	58	50·5	50·4	44·8	42·1	44	42·6
Greatest height ...	26	21	20·4	24	20·5	21·3	18·2
Length of cerebral fossa	33	30·5	30·7	32	27·5	26·3	23·4
Length of cerebellar fossa.....	12·5	13·7	10·8	10·3	9	9·3	8·6
Greatest width of cerebral fossa ...	33	29·4	28·9	29	28	28	23·4

It will be evident from these figures, which represent approximately the cranial development in typical examples of the families Macropodidæ, Phalangeridæ, Dasyuridæ, Phascolomyidæ, and Peramelidæ, that in the extinct form we have an animal in which the relative size of the brain was greater than in existing marsupials; in the total length of the brain, and in the height, length, and breadth of the cerebral hemispheres, it has decidedly the advantage, and as indicating a possible retrogression in cranial development within the marsupial group since Eocene times, the fossil is of peculiar interest.

[1] The cranial cavity has been cleared of matrix since the drawings were made.

[2] This measurement is along the dorsal surface from the front end of the sagittal crest to the tip of the nasal bones, as, owing to the broken under surface, the length from basion to gnathion cannot be taken. In the case of the Kangaroo the difference between the latter and the dorsal length is greater than in the other forms, and causes the relative dimensions of the skull-cavity to be slightly greater than they would be if the more satisfactory measurement of gnathion to basion had been available.

In regard to their dentition as well as to the nature of the fœtal membranes, Wilson and Hill[1] have come to the conclusion that there is very clear evidence of retrogression within the marsupial order, and it appears to be very probable that this retrogression has affected the cranial development.

The Lower Jaw.—Only a fragment of one ramus of the lower jaw (figs. 6 & 7, Pl. L.) is preserved together with a broken-off coronoid process (fig. 8), and, just as in the case of the upper jaw, no teeth are visible. The angle of the jaw has the inward bending so as to form, as seen from below (fig. 7), a flat surface of considerable extent, which evidently formed, as in *Potorous* and *Phalanger*, the floor of a deep and fairly wide depression on the inside of the ascending ramus, which is completely broken away. It differs, however, from that of the Phalangeridæ in being of much greater proportionate length and in running backwards into a long and markedly upturned process, more like that in *Perameles* than in any other form. It will be noticed that there is on the under surface a well-marked ridge which accentuates the convexity of the outline when seen from the side. The structure of the jaw, while distinctly marsupial, is in certain respects unlike that of any known form. The inflected angle, which is in fact longer than is represented in the figure (a broken off portion 8 mm. in length not being represented), is quite unlike that of any existing species both in regard to its length and upward curvature. It must also have been of considerable vertical height, as there were no traces left of even the lower parts of the sockets; and either there were no largely developed incisors, or else the symphysis was a remarkably long one, as there is not a trace of any sockets at the anterior end. The ventral curvature and sharply marked ridge are again characteristic features, while further still there is a curious and inexplicable feature in regard to the ramus, consisting in the presence of a deep depression across the upper surface, which must apparently have been situated in the area occupied by the molar series. It extends in a slanting direction from side to side across the jaw, and its smooth, rounded floor-surface and margins show clearly that it is not a mere break in the jaw. With this is associated a swelling on the internal face, which is well seen in the view from below (fig. 7). What can have been the meaning of this it is impossible to state[2], as it is apparently unlike anything known in any mammalian jaw, while its definite outline and the normal condition of the surface of the bone appear to negative the idea that it is a pathological feature.

The dental foramen is not present, having evidently been placed farther back than the most posterior limit of the preserved portion of the ramus. The mylo-hyoid groove, if present, is only very faintly marked, contrasting in this respect strongly with earlier marsupials,

[1] J. P. Hill, "The Placentation of *Perameles*," Q. J. M. S. vol. xl. p. 435.

[2] The only suggestion which can be made is that possibly it may have been associated with the presence of a large sectorial tooth in the molar or premolar series such as is developed in *Abderites*.

and on the other hand agreeing with the majority of recent ones, in which it is variable and only feebly developed [1].

The coronoid process is that of the right side (fig. 8). It is a remarkably thin plate, in comparison with the general solidity of the other bones, with the anterior and upper margin but little thickened. In comparison with that of other marsupials it is of considerable breadth; there is no concavity on the lower half of the outer surface such as is present in most forms. The form of the posterior curved margin, where it is passing backwards and downwards towards the condyle, may be taken as indicating that the latter was placed fairly high up as regards the angle of the jaw.

Limb-bones.

These are represented by a fairly complete left and a broken right femur; a left tibia broken distally, and a right tibia also broken; a left fibula broken distally and a right more perfect one. No part of the anterior limb or of the foot is preserved.

The Femur (text-fig. 1, and figs. 10, 11, Pl. L.).—The left femur (figs. 10, 11, Pl. L.) is entire except for the upper end of the trochanter, which evidently rose slightly beyond the head. Its total length is 107 mm., and when compared with the corresponding bone of a *Trichosurus*, which is of about equal length, it is at once seen to be remarkable on account of its massiveness. The shaft is straight without any anterior curve, and the posterior surface is flattened. A line passing along the long axis practically cuts through the tip of the great trochanter, the head being turned considerably inwards. The lesser trochanter is characterized by the strong development of the tuberosity at its upper end; while the ridge, which is continued downwards from the great trochanter, has a marked tuberosity at its lower end similar to that which is present in *Phascolomys*. At its ventral distal extremity the shaft swells out, the lateral surface of the outer side being turned, so that it becomes visible in ventral view as in the femurs of *Phascolomys* and *Phascolarctos*. There is also a distinct depression beneath the inner condyle, which is present but not so strongly developed in *Phascolarctos*.

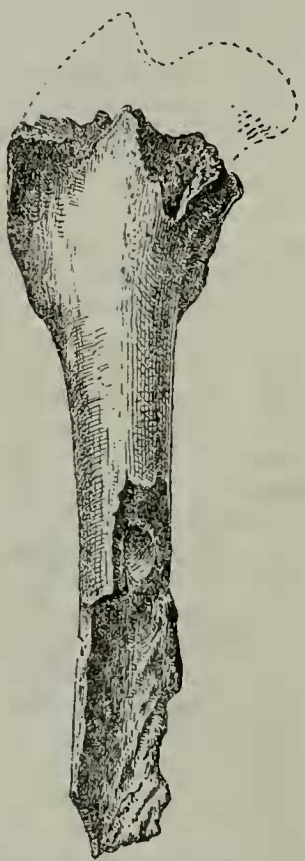
The condyles are of interest because, whilst in marsupials it is characteristic to find the outer larger (in Macropodidæ and Phalangeridæ notably so) than the inner, the reverse condition obtains here, and the inner one is slightly larger than the outer—a point of structure in which the fossil apparently differs from all other Marsupialia.

On the anterior face at the condylar end there is a broad surface with only a slight development of groove, the latter being less marked even than in Phalangers and Dasyures, in which there is a broad, distinctly concave surface with distinct margins. What

[1] H. F. Osborne, "Mesozoic Marsupialia," Journ. Acad. Nat. Sci. Philadelphia, vol. ix. 2, 1888, p. 262.

groove there is in the fossil is only as broad as the deep depression which lies between the condyles posteriorly; starting from this it runs in a slanting direction towards the external side, separating a larger internal rounded eminence from a smaller external one [1].

Fig. 1.



Wynyardia bassiana.

Fig. 1.—Portion of right femur. Nat. size.

Fig. 2.

Fig. 2.—The same. Upper extremity, from above. Nat. size.

The total length of the femur is 107 mm.; the least width, in the centre, is 10 mm.; the greatest width, immediately below the condyle, is 22 mm. Some idea of the relative length of the femur in regard to that of existing marsupials may be gathered from the following list, which represents the length of the femur in proportion to that of the skull in the species named, calculating the length of the skull in each case as 100, that is equal to that of the fossil:—*Trichosurus fuliginosus* 119·5; *Dasyurus maculatus* 95·8; *Pseudochirus herbertensis* 93·8; *P. archeri* 100·8; *Sarcophilus ursinus* 107·6; *Bettongia penicillata* 142·7; *Phascolarctos* 112·5; *Didelphys marsupialis* 80·9; *Phalanger* sp. 89·5; *Phascolomys*

[1] This groove is too strongly marked in fig. 11, Pl. L.; and its depth is shown where it is seen in profile at the extremity of the bone.

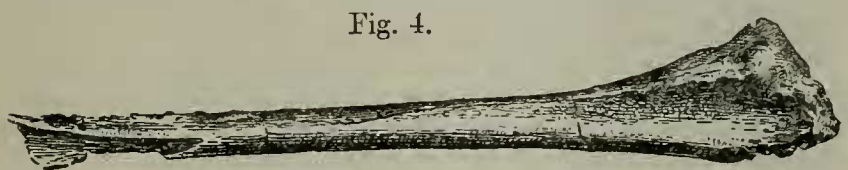
mitchelli 85·4. It will be observed that there is a very considerable variation within the limits of the Phalangeridæ, the fossil having a decidedly shorter femur than is found in *Trichosurus* and a decidedly longer one than in *Phalanger*, while it agrees very closely with that of *Sarcophilus*.

The Tibia (fig. 9, Pl. L.).—The tibia is a strong bone with the shaft much compressed and twisted. At about a fifth of its length from the upper end there is a well-marked tuberosity, flattened from side to side and considerably more prominent than in the tibia of Phalangeridæ or *Dasyurus*, though not so strongly marked as in *Phascolarctos*, where it forms a very prominent structure with an extended broad surface. The inner articular surface of the head is of much greater extent than the outer, in correspondence with the large size of the inner condyle of the femur. In this feature it differs from the tibia of recent marsupials.

Fig. 3.

Wynyardia bassiana. Portion of right fibula, anterior aspect.

Fig. 4.



The same, posterior aspect. Both nat. size.

The Fibula (text-figs. 3 & 4).—The fibula is a complete separate bone. Unfortunately neither fibula is perfect distally, but sufficient of this end of the right one remains to indicate that though the head was somewhat expanded, it was considerably less in size than that of the tibia. The proximal end is much enlarged, the most noticeable features being (1) the fact that evidently the outer condyle of the femur, as in *Thascolomys* and to a certain extent *Phascolarctos*, articulated with the upper of the two articular facets, the outer head of the tibia playing upon the lower one; (2) the extension upwards of the olecranon portion (broken off in the specimen figured), which carries a well-marked surface with which, as in other marsupials, a sesamoid evidently articulated. The lower tuberosity is strongly marked and in general features the head of the fibula rather calls to mind that of *Phascolomys* and to a lesser degree that of *Phascolarctos*. In both of these a line drawn through the middle of the lower tuberosity at right angles to the long axis of the bone lies considerably below the level of the lowest angle of the tuberosity which articulates with the sesamoid, while

in *Trichosurus* and other Phalangerinæ it cuts across the same angle.

The measurements of the tibia and fibula are as follows :—Tibia, length 99 mm.; greatest width of head 25 ; width at tuberosity 13. The comparative lengths of the tibia in the following species, taking in each case the length of the skull as 100, are :—*Trichosurus fuliginosus* 118·4 ; *Dasyurus maculatus* 94·6 ; *Pseudochirus archeri* 97·4 : *Sarcophilus ursinus* 96 ; *Bettongia penicillata* 218 ; *Phascolarctos* 82·6 ; *Didelphys marsupialis* 82·2 ; *Phascolomys mitchelli* 65·2 ; *Phalanger* sp. 80·6.

Fibula, length 99. Comparative length of the fibula in the following species, taking in each the length of the skull as 100 :—*Trichosurus fuliginosus* 115·4 ; *Dasyurus maculatus* 94·6 ; *Pseudochirus archeri* 97·4 ; *Sarcophilus ursinus* 94·2 ; *Bettongia penicillata* 210·9 ; *Phascolarctos* 81·2 ; *Didelphys marsupialis* 71·5 ; *Phascolomys mitchelli* 65·2 ; *Phalanger* sp. 80·6.

It will be noticed that the nearest approach in relative length of both tibia and fibula is met with in *Pseudochirus*, the next nearest being *Dasyurus* and *Sarcophilus*.

Pelvic Girdle. (Fig. 4, Pl. XLIX.)

The parts of this remaining are the acetabular region and ischium and the greater part of the ilium of the right side. The whole girdle is remarkable for its great massiveness.

The ischial portion is somewhat similar to that of *Trichosurus*, the border which lies on the internal side in the acetabular region bending outwards and downwards to the tuber ischii, though it is nothing like so sharply marked as it is in *Trichosurus*, in which it forms a distinct ridge. The acetabular cavity is deeper than in *Trichosurus* or *Dasyurus*, the two margins of the articulating surface approaching more nearly one to the other inferiorly, owing to the fact that the posterior margin which overhangs the cotyloid notch faces somewhat more forwards than it does in the Phalangeridæ or Dasyuridæ. The cotyloid notch is deep, though not so deep as in the Macropodidæ. The synovial cavity is distinctly outlined, but, except in the posterior part, is not overarched by the acetabular border. Owen[1] laid some stress upon the presence of this feature in *Thylacoleo* as being indicative of the alliance of the latter with the carnivorous marsupials, but it is also present in certain herbivorous forms. The shape of the acetabular region on the whole more nearly resembles that of *Phascolomys* than of any other form.

The ilium is unfortunately somewhat broken along its postero-internal or iliac border, but is sufficiently intact to show that it does not closely resemble that of any existing marsupial. The three surfaces—gluteal, iliac, and sacral—are sharply defined, and

[1] "Pelvic Characters of *Thylacoleo carnifex*," Phil. Trans. R. S. part ii. 1883, p. 639.

in certain respects have much the same relationship one to another that they have in the Macropodidæ. They differ markedly from those of the Dasyuridæ, and still more from those of the Phalangeridæ. The bone gradually spreads out towards the crest, which curves out as in the Phalangeridæ, but in the fossil the crest is formed by the union of the gluteal and sacral surfaces. The bone is roughly triangular in section, with two broad and one narrow side, much as in the Macropodidæ, from which, however, it differs strongly in the gradual swelling out towards the crest. The acetabular border, which is rounded proximally, becomes more and more angular distally and curves outwards to the external limit of the crest. The pubic border, which is distinctly marked along its whole length, much as in Macropodidæ, is very sharply defined distally, and between these two borders runs the iliac surface which is distinctly concave distally. The ilium in its broad, flattened distal part with outcurving crest bears only a superficial resemblance to that of the Phalangeridæ, for whereas in the latter the acetabular border lies almost in the middle line of the expanded surface, in the fossil it forms the lower and outer boundary of this, the iliac surface being as it were pushed forwards and downwards so as to form, as in the Macropodidæ, a very distinct antero-inferior surface. From that of *Dasyurus* and *Perameles* the bone differs in that the iliac border does not meet the acetabular, and so obliterate the iliac surface in the upper and distal part, though this obliteration is not quite complete in all specimens of *Dasyurus*.

The marsupial bones are well developed, and fortunately one of them is in a good state of preservation. It is straight, flattened, and considerably expanded at the proximal extremity, where, as in the Wombat, there are two distinct surfaces for articulation with the pubis. They differ markedly from those of the Phalangeridæ both in size and in the absence of the curve which is characteristic of the bone in such forms as *Trichosurus*. The length of the bone is 55 mm.; that of the corresponding bone in a *Trichosurus*, the femur and skull of which are of approximately the same length as those of the fossil, being only 31 mm. In shape the bone is closely similar to that of the Wombat, though relatively larger; in fact it is as large in proportion to the ilium as in *Phascolarctos*, though it is markedly different from that of the latter in being straight instead of strongly curved. The width of the expanded proximal end is 22 mm.; at 11 mm. from this end the width is 9 mm.; at 15 it is 6 mm., and this width is continued to the distal end.

Sacrum.

Only a broken portion of the sacrum is preserved, showing the bodies of three fused vertebræ. The transverse processes are too broken to allow of the method of attachment of the ilia being determined, but the bodies and processes of the three are firmly fused together. The neural spine of the first is broad and flattened, measuring 14 mm. in length; the total height cannot be ascertained,

as it is broken off at a height of 12·5 mm. It slants slightly forwards.

Vertebral Column.

Of the vertebral column there remains the broken axis and a continuous series of 9 vertebræ belonging to the presacral region. The axis has the odontoid process firmly attached. The articular surface is elongate, its length being 10 mm.; the anterior margin of the neural arch arises at the level of the posterior end of the articular surface, and is almost vertical, the under surface of the overhanging end of the neural spine forming almost a right angle with it. The exact extent of the spine cannot be determined as the posterior part is broken. The transverse process differs from that of marsupials generally (ex. *Trichosurus*, *Dasyurus*, *Perameles*, *Macropus*) in running out nearly at right angles to the body. It is stoutly built and relatively short. The width (11 mm.) of the neural cavity is decidedly greater than its height (7·5), a condition which does not usually obtain in marsupials; in a specimen of *Dendrolagus bennettianus* both width and height are 9 mm.; in *Trichosurus* both are 7 mm.; in *Dasyurus viverrinus* and *Perameles gunni* the height is 5 mm., the width a shade greater; in *Phascolomys* the width is 15, the height 12; and in *Macropus rufus* the width is 16 and the height 11·5. The ridge of bone which forms the floor of the vertebrarterial canal instead of being, as in recent marsupials, narrowed from before backwards so that there is a distinct open space between the backwardly slanting process and the centrum ventrally, is expanded so as to form a platform which serves as a floor for the vertebrarterial canal. In ventral view there is a low median keel; this runs forwards to meet a ridge which runs across the anterior end of the centrum and then diverges outwards on each side, when it is confluent with the lower edge of the articular surface, and then passes outwards on to the process at the base of the vertebrarterial canal. The space between this ridge on either side and the median keel is occupied by a platform of bone across which runs a small ridge. This platform, stretching across between the process and the centrum, is a distinctive feature of the axis of the fossil form, and is not met with in recent marsupials.

The remaining vertebræ are all considerably broken; they are lying on their right side, the processes of the left side being all broken off. Under the four anterior ones there lie the broken remains of ribs.

The total length of this part of the vertebral column is 191 mm.; that of a corresponding part of a *Trichosurus vulpecula*, of which the skull is slightly smaller than that of the fossil, is 160 mm. Owing to their broken state it is not possible to determine which of them carried ribs. The third from the anterior end is the only one in which the neural spine is preserved; it has the form of a broad plate slanting backwards, with a length of 14 mm. at its base and 12 along its dorsal margin; its anterior, backwardly

sloping margin measures 9 mm.; its vertical height is 7 mm. It gradually thickens from before backwards, the width of the somewhat swollen dorsal surface being 2 mm. in front and 4 mm. behind. The length of the broken base of the neural spine of the vertebra next in front is 16 mm. Its general form is much like that of *Trichosurus*, only much enlarged, the corresponding process in a *T. vulpecula* (with a skull of almost the same size as that of the fossil) being 8 mm. in length and 4 mm. in vertical height.

The metapophyses are well developed, and fit in between the posterior zygapophyses and the anapophyses. The latter are well developed, forming rounded processes on four of the vertebræ, those of the last two being broken off; they gradually diminish in size from before backwards. The zygapophyses and associated metapophyses lie in a more horizontal plane than they do in *Trichosurus* and other forms, their general relationship being very much that which obtains in *Dendrolagus*.

The most striking feature in regard to these presacral vertebræ is the structure of the transverse processes, which are unlike those of any existing marsupial. They are well developed on all the last five vertebræ, but in front of this cannot be seen, owing to the manner in which the ribs have been pressed up against the vertebral column. The most perfectly preserved one is that on the fourth vertebra counting from the posterior end; here it has the form of a flat plate slightly increasing in width towards the free end and slightly slanting forwards, both its anterior and posterior edges being straight. The width of the attached end is 10 mm. and of the free end 12 mm.; the length of the process is 15·5 mm. On the vertebra in front of this the width at the attached end is 11 mm. and the length 12 mm., the anterior edge being slightly concave. On the vertebra behind, the process is broken off close to its base, while on the next vertebra it is directed outwards at right angles to the length of the body, has a length of 16 mm. and a uniform width of 9 mm. In the last of the presacral vertebræ the shape is different; for the length of 5 mm. the proximal part lies at right angles to the body, but beyond this the process bends forwards, the total length being 22 mm. The process, which only measures 7 mm. in width, is marked by a ridge which runs obliquely across its width, continuing the line of the curved front edge of the distal part. All of the processes run in an almost horizontal plane, as they do in *Phascolomys*; but whereas in the latter they are long and narrow, here they are long and broad, unlike those of existing marsupials except to a slight extent those of *Phascolarctos*, in which, however, they are relatively much smaller.

Summary of Important Points.

(1) Proportionate length to the breadth of the skull, 100 : 67. This approximates most nearly to *Dasyurus*, and shows a decidedly greater proportionate width than in the Phalangeridæ.

(2) Lambdoidal crest well developed, as in *Dasyurus*.

(3) Sagittal crest strongly developed, resembling that of Dasyuridæ and species of *Didelphys*.

(4) Large size of the squamosal. This is more strongly marked than in any recent marsupial except perhaps *Phascolomys*. The dorsal suture of the squamosal runs generally parallel to the sagittal crest as in Dasyuridæ and does not converge posteriorly as it does in Phalangeridæ.

(5) The wide sweep and upward curvature of the zygomatic arches, as in Dasyuridæ.

(6) The entire absence of the inflated part of the squamosal, which is characteristic of the Phalangeridæ generally.

(7) The transverse elongation of the glenoid cavity, the downward produced plate of bone which forms the boundary is not connected with any structure forming part of the auditory passage. In this respect it agrees with Dasyuridæ and *Perameles*, and differs markedly from the Phalangeridæ, amongst which it forms the anterior part of a bony auditory canal.

(8) The position of the glenoid cavity in reference to the base of the skull. In the relatively high position of this it approximates most nearly to the Phalangeridæ, though it is placed somewhat lower than in these.

(9) The greatest breadth of the frontals is in the cranial part. In this the fossil differs apparently from all recent marsupials.

(10) The large size of the lachrymals, which meet the nasals as they do in *Phascolomys*.

(11) The great width of the nasals. In their general shape the bones are closely similar to those of certain species of *Didelphys*.

(12) The forward extension of the nasals, as in the Phalangeridæ and certain Didelphyidæ, and in contrast to what obtains amongst the Dasyuridæ.

(13) The very anterior position of the infraorbital foramen.

(14) The development of a groove running forward from the foramen rotundum to the fossa gasseriana. In this it agrees with *Macropus*, *Sarcophilus*, and *Dasyurus*.

(15) The structure of the periotic bone, which is quite unlike that of any other marsupial.

(16) The size and shape of the premaxillæ, which are very similar to those of *Trichosurus* and may probably be regarded as indicating the presence of a fair-sized incisor dentition.

(17) The relative size of the cranial cavity, which is greater than that in any recent marsupial.

(18) The great length of the inflected angle of the lower jaw and the height to which it rises. This characteristic marsupial feature is strongly emphasized in the fossil.

(19) The probable high position of the articulating surface of the lower jaw.

(20) The remarkable obliquely transverse groove in the lower jaw.

(21) The strongly marked curved ridge on the under surface of the lower jaw.

(22) The massive nature of the femur and the fact that the inner condyle is larger than the outer one, which is the reverse condition of that which is typical of recent marsupials.

(23) The strong development of the tuberosity at the upper end of the lesser trochanter, and the presence of a tuberosity at the lower end of the ridge which is continued down from the great trochanter. The latter feature is met with in *Phascolomys*.

(24) The position of the head of the femur, which is turned considerably inwards.

(25) The proportionate length of the femur to that of the head. It is longer than in *Trichosurus*, shorter than in *Phalanger*, and agrees most nearly with that of *Sarcophilus*.

(26) The strong development of the anterior tuberosity in the tibia. This is more strongly developed than in Phalangeridæ and *Dasyurus*, but not so strongly as in *Phascolarctos*.

(27) The distal head of the fibula is somewhat less in size than that of the tibia.

(28) The upward extension of the olecranon portion of the fibula is considerable and most resembles that found in *Phascolomys*. The outer condyle of the head articulates with the femur.

(29) The proportionate length of the fibula and tibia to that of the skull is nearest to that of *Pseudochirus*.

(30) The ischium is massive and shows a general resemblance in form to that of *Trichosurus*.

(31) The acetabular region is most similar to that of *Phascolomys*, the lower part only of the distal acetabular border overhangs the synovial cavity in the region of the cotyloid notch. The notch is fairly deep, and the whole acetabular region resembles most nearly that of *Phascolomys*.

(32) The ilium is unlike that of any recent marsupial. It has the trihedral form of *Macropus* or *Dendrolagus*, but combined with this the distal expansion characteristic of other forms, such as the Phalangeridæ, from which, however, it differs markedly in essential structure.

(33) The great size and straightness of the marsupial bones, which have two articulating surfaces as in *Phascolomys*.

(34) The sacrum consists of three fused vertebræ. This occurs in *Dasyurus viverrinus*.

(35) The structure of the axis, in which the transverse process runs out almost at right angles to the body, and the ridge which forms the base of the vertebrarterial canal is flattened out, instead of being narrowed from before backward as in all recent marsupials.

(36) The transverse processes are large broad plates running out almost horizontally: they are unlike those of any recent marsupial.

It will be seen from the above that the fossil presents a remarkable combination of characters, some of which serve to distinguish it from recent marsupials, while others serve to ally it on the one

hand with existing Polyprotodontia, and on the other with existing Diprotodontia.

If we had only the anterior part of the skull preserved, there is but little doubt that it would be referred to the Phalangeridæ; but, on the other hand, if we had only the hinder part showing the strong sagittal crest, the low origin and wide sweep of the zygomatic arch, it would be referred to the Dasyuridæ; the ilium alone would be regarded as belonging to an animal more allied to *Dendrolagus* than to any existing marsupial; while the head of the fibula would be regarded as indicating affinity to *Phascolomys*. We may divide the more important characters into three groups as follows:—

(1) Those in which it differs from recent marsupials. These characters are seen in numbers 9, 13, 15, 17, 22, 32, 35, 36. The most important features in connection with these is the greater relative size of the cranial cavity, in conjunction with the fact that the greatest breadth of the frontal bones lies in the cranial and not in the facial region. There is no indication of affinity with any special group outside of the marsupials, but an indication that within the marsupials retrogression has most probably taken place in this respect.

(2) Those in which it shows alliance with the Polyprotodontia. These are seen in numbers 1, 2, 3, 5, 7, in all of which it shows a decided alliance with the Dasyuridæ.

(3) Those in which it shows alliance with the Diprotodontia. These are seen in numbers 8 (to a certain extent), 12 (to a certain extent, though this character is common to Didelphyidæ), 16, 19, 28, 29, 30, 31, 32. In some of these features it shows alliance with the Phalangeridæ and in others with *Phascolomys*, and in 32 with Macropodidæ to a certain extent.

In the complete absence of teeth and of the bones of both fore and hind feet, it is unsafe to attempt to refer it to any existing family; there are, indeed, only two which could possibly be considered in this respect—the Dasyuridæ and Phalangeridæ. From both of these it differs in the points mentioned in the first group: from the Dasyuridæ in the characters mentioned in the third group as well as in 4 (in part), 18, 32, and 33; from the Phalangeridæ in those of the second group as well as in 4, 6, 18, 28, 32, 33, 34.

The structure of the premaxillæ appears to indicate the existence of a fair-sized incisor dentition; and a consideration of all the features would appear to lead to the conclusion that the fossil is the representative of a now extinct series of forms which were more nearly allied to ancestral Polyprotodonts than are any of the existing Diprotodont forms. It may, in fact, be regarded as intermediate between the former and the latter, and as indicative of a stage in the development of Australian marsupials when the ancestors of the recent Diprotodontia were beginning to diverge from the original Polyprotodontid stock from which they have been developed within the limits of the Australian region.

Melbourne, May 1900.